

## The prevalence of SDQ-measured mental health problems at age 5–7 years and identification of predictors from birth to preschool age in a Danish birth cohort: The Copenhagen Child Cohort 2000

Elberling, Hanne; Linneberg, Allan; Olsen, Else Marie; Goodman, Robert; Skovgaard, Anne Mette

Postprint / Postprint

Zeitschriftenartikel / journal article

Zur Verfügung gestellt in Kooperation mit / provided in cooperation with:

[www.peerproject.eu](http://www.peerproject.eu)

### Empfohlene Zitierung / Suggested Citation:

Elberling, H., Linneberg, A., Olsen, E. M., Goodman, R., & Skovgaard, A. M. (2010). The prevalence of SDQ-measured mental health problems at age 5–7 years and identification of predictors from birth to preschool age in a Danish birth cohort: The Copenhagen Child Cohort 2000. *European Child & Adolescent Psychiatry*, 19(9), 725-735. <https://doi.org/10.1007/s00787-010-0110-z>

### Nutzungsbedingungen:

Dieser Text wird unter dem "PEER Licence Agreement zur Verfügung" gestellt. Nähere Auskünfte zum PEER-Projekt finden Sie hier: <http://www.peerproject.eu> Gewährt wird ein nicht exklusives, nicht übertragbares, persönliches und beschränktes Recht auf Nutzung dieses Dokuments. Dieses Dokument ist ausschließlich für den persönlichen, nicht-kommerziellen Gebrauch bestimmt. Auf sämtlichen Kopien dieses Dokuments müssen alle Urheberrechtshinweise und sonstigen Hinweise auf gesetzlichen Schutz beibehalten werden. Sie dürfen dieses Dokument nicht in irgendeiner Weise abändern, noch dürfen Sie dieses Dokument für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen.

Mit der Verwendung dieses Dokuments erkennen Sie die Nutzungsbedingungen an.

**gesis**  
Leibniz-Institut  
für Sozialwissenschaften

### Terms of use:

This document is made available under the "PEER Licence Agreement". For more information regarding the PEER-project see: <http://www.peerproject.eu> This document is solely intended for your personal, non-commercial use. All of the copies of this documents must retain all copyright information and other information regarding legal protection. You are not allowed to alter this document in any way, to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public.

By using this particular document, you accept the above-stated conditions of use.

Mitglied der  
  
Leibniz-Gemeinschaft

## Title

The prevalence of SDQ-measured mental health problems at age 5-7 years and identification of predictors from birth to preschool age in a Danish birth cohort: The Copenhagen Child Cohort 2000

## Authors

Hanne Elberling, MD<sup>1,2</sup>, Allan Linneberg, MD, PhD<sup>2,3</sup>, Else Marie Olsen, MD, PhD<sup>1</sup>, Robert Goodman, PhD<sup>4</sup>, Anne Mette Skovgaard, MD, Dr. Med. Sci<sup>1,3</sup>

## Corresponding author

Hanne Elberling, Research Centre for Prevention and Health, Department 84/85, Copenhagen University Hospital Glostrup, Ndr. Ringvej 69, 2600 Glostrup, Department 84/85, Ringvejen; 2600 Glostrup, Denmark, phone + 45 43233256 email: hanneelberling@yahoo.com

<sup>1</sup> Child and Adolescent Psychiatry Centre, Copenhagen University Hospital Glostrup, Capital Region, Denmark

<sup>2</sup> Research Centre for Prevention and Health, Copenhagen University Hospital Glostrup, Capital Region, Denmark

<sup>3</sup> University of Copenhagen, Denmark

<sup>4</sup> King's College London Institute of Psychiatry, Department of Child and Adolescent Psychiatry, United Kingdom

Keywords: child, mental health problems, prevalence, SDQ, birth cohort

Abbreviations: SDQ: Strengths and Difficulties Questionnaire, DAWBA: Development and Well-Being Assessment,

OR: Odds ratio, RR: risk ratio, CI: Confidence intervals, p: parents, t: pre-school teachers.

Abstract word count: 259 words

Text word count: 5538 words

## **Abstract**

**Objective:** To investigate the prevalence, distribution and predictors of mental health problems in 5-7 year old Danish children in the general population.

**Material and methods:** This study is a 5-7 year follow-up study of a birth cohort of 6,090 children, the Copenhagen Child Cohort 2000. The extended version of the Strengths and Difficulties Questionnaire (SDQ) was answered by parents and pre-school teachers. Data from Danish national registers included perinatal data, socioeconomic data and data on child mental illness diagnosed at hospital in preschool age.

**Results:** Register data from the first year of life was obtained from 99.7% of the children in the cohort. Of 5,898 eligible children, 3,501 participated in the SDQ assessment (59%). The overall estimated 6-month prevalence of mental health problems was 4.8% (95% CI: 4.1-5.6). Conduct problems were found in 3.0% (95% CI: 2.4-3.6), problems of hyperactivity/inattention in 0.7% (95% CI: 0.4-1.0) and emotional problems in 1.5% (95% CI: 1.1-1.9).

Boys showed a higher risk of having mental health problems compared to girls: risk ratio 2.0 (95% CI 1.5-2.8). Several markers of socioeconomic disadvantages were associated with mental health problems at 5-7 years of age.

**Conclusions:** The 6-month prevalence of SDQ-measured mental health problems was relatively low in Danish children when compared with findings from several European countries, but were in line with findings from other studies in Nordic countries. The lower prevalence might reflect differences in in psycho-social risk load and environmental stress given the social and cultural context.

## **Background**

Psychiatric disorders with their origin in childhood are considerable contributors to the global burden of diseases [1], and half of all lifetime cases of any psychiatric disorder seem to have their beginning before the age of 15 years [2]. Data from longitudinal studies point to the persistency of psychopathology from childhood through pre-adolescence and adolescence although the individual symptom patterns seem to change over time [3-6].

Epidemiological data on the frequency and distribution of mental health problems at different ages in childhood are essential for service planning and prevention and furthermore as a useful first step in the investigation of the significance of psychopathology in childhood [1;3].

Standardized measures are essential to ensure the validity of case-definition and to facilitate comparison of child mental health problems and risk factors across countries and over time [1;3;7]. The Strengths and Difficulties Questionnaire, SDQ, is a standardized questionnaire used to assess mental health problems and resultant impairment in children and adolescents. It was developed and evaluated in Great Britain [8-11] and extensive use and evaluation in many countries and different cultures has increased its usefulness for comparisons between countries [7;12;13].

Prevalence studies using the SDQ have found functionally impairing psychopathology in 10-15% of 5-15 year olds children and adolescents [14;15]. The patterns of mental health problems vary across cultures and over time [3;4;6;15]. Relatively lower scores of SDQ-measured problems have been found in children from Nordic countries in contrast to other industrialized countries [13;15;16].

The Copenhagen Child Cohort 2000 (CCC2000) is a prospective study of mental health problems and psychopathology in a Danish birth cohort. The overall aim of the CCC2000 is to study the presentation, developmental pathways and risk mechanisms of psychopathology longitudinally from birth [17].

The present study is a follow-up of CCC2000 to estimate the 6-month prevalence, distribution and comorbidity of SDQ-measured mental health problems in children aged 5-7 year. An additional aim was to investigate possible predictors of mental health problems of this age. Information on putative risk factors was obtained from Danish National Registers.

## **Methods**

### **Study population**

The Copenhagen Child Cohort 2000, CCC2000 is a birth cohort that consists of all children born in 16 municipalities in the county of Copenhagen in a one-year period from 1<sup>st</sup> of January to 31<sup>st</sup> of December 2000, comprising a total of 6,090 children. Children not living in Denmark at the time of the investigation were excluded. There was no other criteria for exclusion.

The CCC2000 covers 9% of children born in Denmark during the year 2000 and is representative of the general population of Danish children born that year with regard to the distribution of gender and birth parameters. The methodology of the CCC2000 baseline study cohort has been described in more detail elsewhere [17].

### **Recruitment**

Information about the child and current place of residence for this wave of the study was obtained from the Danish Civil Register. Out of 6,090 children, 6072 (99.7%) children could be identified in the Danish National Registers (18 children (0.3%) died before they could enter the follow-up study). A total of 174 children were not eligible for the SDQ investigation: 136 (0.2%) lived abroad, 29 (0.5%) had no known address and 9 (0.1%) were missing from the Danish Civil Register. Thus, a total of 5,898 (97%) children were eligible for the SDQ investigation at the 5-7 year follow-up. The study was carried out from August 2005 to April 2007. The parents were mailed an invitation letter with information about the study and were asked to complete and return an enclosed copy of the SDQ. In addition, parents were asked to relay an SDQ to the child's pre-school teacher as well. A reminder was mailed after 3 weeks to parents who had not responded. The parents and pre-school teachers returned their questionnaires separately. Parents who had problems answering the questionnaire because of difficulties with the Danish language were offered help with the translation of the questions.

### **Instrument**

Mental health problems were measured by the Strengths and Difficulties Questionnaire, SDQ, which is a 25 item screening questionnaire in which parents and pre-school teachers report on how the child has been in the past 6-months [8;9;11]. The items are divided in five scales of five items, each, generating scores for emotional symptoms, conduct

problems, hyperactivity/inattention, peer relationship problems, and pro-social behaviour. The five scales are each scored from 0-10 and classified as “normal”, “borderline”, or “abnormal”.

A total difficulties score is calculated as the sum of scores of the conduct, hyperactivity, emotional and peer problems scales [8;18]. The extended version of the SDQ used in this study includes questions on whether the respondent believes that the child “had difficulties in one or more of the following areas: emotions, concentration, behaviour or being able to get along with other people”. If a problem is reported, the respondent is asked additional questions about distress, social impairment, burden and chronicity [9].

A computerised algorithm brings together the answers from parents and pre-school teachers on symptoms and impact to estimate the probability of mental health problems [10;14;19]. The algorithm makes separate predictions of conduct-oppositional problems, hyperactivity-inattention problems and emotional problems and generates an overall prediction regarding probable, possible or unlikely mental health problems [10]. In summary, the algorithm predicts disorders on the basis of the combination of high symptom and impact scores. Probable conduct-oppositional and emotional disorders can be predicted on the basis of high symptoms and impact reported by just one respondent (since these disorders can be situational). Conversely, a probable hyperactivity-inattention disorder is only predicted when there is supporting evidence from both the parent and preschool teacher (since ADHD and hyperkinesia are expected to be pervasive across situations).

Using this algorithm to combine data from different informants has been shown to identify psychiatric diagnoses in children with a specificity of 80-95%, a sensitivity of 63%-85% and the positive and negative predictive value of respectively 54% and 96% in a general population [10]. The SDQ has been used in both industrialized countries and in less developed countries [19], suggesting that the questionnaire can be used in different cultural settings.

The SDQ has been translated into Danish and used in general population studies of Danish children, however with no available psychometric data [20].

Since the transition from preschool to school does not happen until the age of 7 in Denmark, a few SDQ questions were modified, substituting “kindergarten” for “school”, and “pre-school teacher” instead of “teacher”.

(For further information, see [www.sdqinfo.com](http://www.sdqinfo.com).)

In this study children were defined as having impairing mental health problems if they were classified as having “probable” mental health problems by the SDQ algorithm; they are contrasted with the rest of the sample who were classified by the algorithm as having “unlikely” or “possible” mental health problems. Mental health problems are

further described using the total difficulties score and specific SDQ symptom and impact scores, all generated using standard procedures [8;9;18].

#### Register data

Data from Danish National Registers were used for attrition analysis and to obtain data on perinatal adversities and putative psycho-social risk factors.

In Denmark, all citizens have a unique personal identification number which follows the person through out life. The personal ID number is used by all central registers and authorities including the health care system. Furthermore, it is possible to obtain valid information on the socioeconomic status of the parents of each individual child.

Data from the Medical Birth Register included birth weight, gestational age, apgar score (a method of evaluating the physical condition of a newborn infant shortly after delivery. Normal apgar score is 10), birth complications and serious malformation. Data on hospital admissions included diagnoses on mental health disorders (ICD-10 F-diagnoses) obtained from the National Patient Register and the Psychiatric Central Register. Data on socio-economic variables in the family were obtained from Integrated Database for Labour Market Research. Overall, data on 99.7% of the birth cohort were obtained via these registers.

#### **Ethics**

The project was approved by the Scientific Ethics Committee of Copenhagen County (KA-05103) and the Danish Data Protection Agency (2007-41-1361).

#### **Statistical analysis**

The chi square test was used to evaluate differences between groups. Prevalence estimates were given with 95% confidence intervals (CI). A weighting procedure based on direct standardization [21] was applied to take account of the way in which responders differed from the target population in health and socioeconomic risk factors.

For example, a weighted estimate of the prevalence of mental health problems in the sample studied (responders) assuming the same gender distribution as in the entire sample (including both responders and non-responders).

Test of Marginal Homogeneity was used for analyses of the differences in SDQ scores categorized as normal, borderline and abnormal in children with 2 informants.

Because of non-homogeneity of variances, the Wilcoxon Signed Rank test was used to investigate the differences in median SDQ symptom scores derived from parent and pre-school teachers.

Kappa coefficients were calculated to investigate the agreement in SDQ symptom scores between parents and pre-school teachers.

Children with “probable” mental health problems as predicted by the SDQ algorithm were compared on perinatal adversities and socioeconomic risk factors with children where mental health problems were predicted to be “possible” or “unlikely”. Subsequently, predicted mental health problems were dichotomised as probable or not (i.e. combining “possible” and “unlikely”) and multivariate logistic regression was performed, including independent variables which were found to be associated with mental health problems in univariate analyses ( $p < 0.1$ ). The multiple logistic regression analysis estimated the independent effect of the variables while controlling for effect of child gender and maternal age. Differences in mental health problems by gender and by the number of SDQ informants are reported as risk ratio, RR with 95% CI.

Statistics were performed with the statistical program SAS, version 9.2 (SAS Institute Inc, Cary, NC, USA)



## Results

Of 5,898 children eligible for the SDQ study, questionnaires were completed on a total of 3,501 (59%). Parent questionnaires were obtained on 3,349 children (57%) and pre-school teacher questionnaires on 2,594 children (44%). Questionnaires from both parents and pre-school teachers were obtained on 2,442 children (41%). Information from parents only was available on 907 children; and information from pre-school teachers only was available on 152 children. The gender distribution was 1,775 (51%) boys and 1,726 (49 %) girls. The mean age (SD) was 5.4 (0.3).

Table 1 shows background characteristics of the CCC 2000 cohort. The following characteristics were over-represented among non-responders: parents who were not born in Denmark; low household income; younger mothers; low maternal education; parents living separately at the time of birth; and changed family composition in the first 5 years of life. No differences in the distribution of perinatal adversities were found, except for a small, but statistically significant difference in mean birth weight (3,535 grams in children with SDQ data as compared with 3,449 grams in non-participants).

### Table 1 about here

#### Prevalence of mental health problems

The 6-month prevalence of mental health problems predicted by the SDQ algorithm is shown in table 2. Among the 3,501 participants, 168 were classified as having mental health problems, which corresponds to an overall 6-month prevalence estimate of 4.8% for participants. A further 513 children (14.7%) were classified as “possible” cases and 2,781 (79.4%) children were classified as “unlikely.”

The analyses were repeated using weights to adjust for differential non-response, with only a slight increase in estimated 6-month prevalence from 4.8% to 5.0% (95% CI 4.2-5.8). The weighting procedure is described in the section on statistical analysis.

Among the different types of mental health problems, conduct problems were the most common, found in 3%, followed by emotional problems, found in 1.5%, and hyperactivity/inattention in 0.7%. Boys were at a higher risk of having at least one mental health problem as compared to girls: RR 2.0 and at a significantly higher risk in all types of mental health problems except for emotional problems.

**Table 2 about here**

Table 3 shows a comparison of parent and pre-school teacher ratings in the 2,442 children with information from both a parent and a pre-school teacher. Among these children, 3.6% (N=88) had a total difficulties score in the abnormal range as judged by parent report, but significantly more children, namely 5.9 % (N=143), had abnormal scores as judged by pre-school teacher report (table 3). When looking at measures of impact, a total of 114 children (4.8 %) had an abnormal impact score according to their parent report, whereas 147 children (6.2%) had an abnormal impact according to their preschool teacher report. The most common mental health problems reported by parents were emotional problems (7.4% in abnormal range), whereas problems of hyperactivity/ inattention were the most common reported by pre-school teachers (9.0% in abnormal range). The agreement of parents and the pre-school teachers in their reports on child mental health problems was in general low, as indicated by a Kappa value ranging from 0.09 to 0.29 Children with information from preschool teachers only were more likely to have an abnormal high total difficulties score compared to children with SDQ completed by both parents and pre-school teachers: RR 3.2 (95% CI 2.2-4.7). However, no difference in risk was seen regarding children with parent reports only. There was no significant difference in gender for children with missing reports from parents and the preschool teacher.

**Table 3 about here**

Co-occurrence of mental health problems at child age 5-7 years

Among children with mental health problems, 7% had overlap across two main SDQ subgroups, primarily due to the co-occurrence of conduct problems in more than a third of the children with hyperactivity/inattention problems. (figure 1).

**Fig 1 about here**

Predictors of mental health problems at 5-7 years

Table 4 shows perinatal and socioeconomic variables associated mental health problems in children aged 5-7 years. The only significant child-related factors were being a boy and having been diagnosed at hospital with a mental health

disorder in the first four years of life. No significant associations were found with regard to markers of perinatal adversities or illness..

Socioeconomic factors significantly associated with mental health problems at 5-7 years were immigrant parents, teenage mothers, less educated mothers, lower household income, parents living separately at the time of the birth, and the child being exposed to changes in family composition in their first 5 years of life. No significant association was found with regard to paternal age, parity at birth, the social status of the living areas at birth.

**Table 4 about here**

All variables significantly ( $p < 0.1$ ) associated with mental health problems ( $p < 0.1$ ) were included in multivariate models (logistic regression) adjusted for gender and maternal age (table 5). Male gender was the only characteristics of the child that was significantly and independently associated with mental health problems, OR 2.11. Overall, gestational age was not significantly associated with mental health problems, although children with gestational age below 31 weeks were associated with higher risk of mental health problems compared to children born after the 36<sup>th</sup> week. Several features or correlates of social and economic disadvantage predicted mental health problems in the multivariate model: young maternal age, low household income at the time of birth and the child living without any biological parents or with a single parent in the first year of life.

**Table 5 about here**

**Discussion**

In this 5-7 years follow-up of the birth cohort CCC 2000, we found a 4.8% 6-month prevalence of mental health problems assessed by parent and preschool teacher SDQs. The participation rate was 59% and analyses of attrition showed that some psycho-social risk factors were more frequent in non-participants. However, estimates of prevalence, weighted according to differential non-response only increased the prevalence from 4.8% to 5.0%. The prevalence estimates in the present study correspond closely to the 5% prevalence reported by a Danish study of parent SDQ scores in 4,971 children at 7 years of age though this study did not include teacher reports or questions about impact [22]. Conduct problems were the most common mental health problem, found in 3%. Problems of hyperactivity and inattention were found in 0.7 %, with nearly half of these children also having conduct or emotional problems.

The results from the present Danish study correspond to findings in studies from other Nordic countries, both with regard to the SDQ total difficulties mean scores reported by parents and with regard to the specific symptom scores [13;15;16], whereas SDQ studies from other countries in Europe have found higher estimates of prevalence, ranging from 6.3%-9.8%. [18;23-25].

A study of 5855 children aged 5-10 years from Great Britain [18] thus showed a total difficulties score of 9.6 % (teacher reports) and 9.9 % (parent reports), contrasting with the lower rate found in the present study of 5.9 % (preschool teachers reports) and 3.6 % (parents reports). Similarly, the frequency of abnormal symptom scores was lower in all areas in Danish children when compared to British children. In particular with regard to hyperactivity/inattention, where the proportion of Danish children with abnormal symptom scores was 5.6 % (parent reports) and 9.0 % (preschool teacher reports), whereas the corresponding figures in British children were 16 % (parents reports) and 13.8 % (teachers reports).

In a cross-cultural comparison of findings from prevalence studies from Norway and Great Britain, it was shown that a lower prevalence of emotional problems in Norwegian children compared to British children could be explained by Norwegian parents under-reporting emotional symptoms, whereas a lower prevalence of conduct problems and hyperactivity/inattention in Norwegian children was considered to reflect a real advantages in child mental health in Nordic countries [13].

As compared with children in many previously studies, the present CCC2000 sample were younger and had more equal access to social and educational facilities. This could partly explain a lower prevalence [3;13;15]. It is noteworthy that we found an even lower rates of conduct problems and hyperactivity/ inattention problems than the study of Norwegian children. It is also striking that our rate of hyperactivity/inattention problems was so much lower than the 6.4% prevalence of ADHD reported by a study of Danish children at age 8-10 years [26]. Our low prevalence rates should be interpreted in the context of the study. The mean age of the CCC 2000 children in the present study was 5.4 years, and only 4.3% of the children had started school at the time of the SDQ investigation. Instead, they spent their day-time in kindergarten, mostly engaged in free play and outdoors activities – a setting that is much freer from discipline and rules than school. By contrast, children in the majority of European countries start school or school-like day-care before the age of 5 years, and the study from Norway SDQ investigated children at age 8-10 years in school settings. Thus if mental health problems are precipitated or aggravated by the external pressures and demands of school, this could contribute to our lower prevalence. In addition, hyperactivity/inattention symptoms may be under-detected in a

kindergarten setting since pre-school teachers have less opportunity than school teachers to observe children engaged in tasks that require detailed knowledge and concentration.

In the CCC2000 study we found low agreement between parents and teachers reports, with low Kappas for all scales of mental health problems. In addition, there were significant differences in the means SDQ scores from parents and preschool teachers for all SDQ scores other than the peer problem score. Pre-school teachers were reporting more problems than parents in all areas of mental health other than emotional problems and peer problems. Particularly given the low agreement between parents and pre-school teachers found in the present study, the rate of problems may have been underestimated in the quarter of the study population with just one informant.

In conclusion, the relatively low prevalence in Danish pre-school children might thus be substantive and reflect a population at relatively low risk load and at an age characterised by a low exposure to environmental stress and , possibly also reflect methodological shortcomings (underdetection).

#### Factors associated with mental health problems at age 5-7 years

Male gender was associated with an overall risk of mental health problems and with a higher risk of conduct problems and hyperactivity/inattention which is in accordance with findings in studies of children at other ages and from other cultures [14;16]. Socioeconomic risk factors for mental health problems at child age 5-7 years included young maternal age, low household income, and the child living with a single parent or without any biological parents at the time of birth. Previous studies have found socioeconomic risk factors associated with in particular emotional and conduct disorders [16]. In the CCC2000 study where the majority (94%) of child mental health problems were emotional or conduct problems, we found socioeconomic risk factors being the only significant predictors.

Corresponding associations have been reported in studies of Norwegian and the British children, although only male gender and family type associated with higher risk of conduct problems in the Norwegian study, whereas overall mental health problems were associated with markers of poverty [13;15;16].

Even though this describes predictors and not causal mechanism, it is still a useful reminder of the need for mental health services to focus on children in families with well known socioeconomic risks[27].

#### Limitations

The main limitation of the study concerns the relatively low rate of participation (59%), particularly among disadvantaged groups where children might plausibly have been more prone to develop mental health problems. This

bias may have resulted in underestimation of the prevalence of mental health problems. However, use of data from National registers made it possible to calculate the weighted prevalence adjusting for non-response, and this did not result in any substantial changes in prevalence.

Another limitation concern the possible informant bias as 26% of the children had missing information from one informant, as has been discussed above.

Finally, the Danish version of SDQ has been forward- and backward-translated as recommended by The World Health Organization [28] but the SDQ has not yet been validated on Danish populations. However, measures of validity and reliability have been established in other European countries – validation studies from Norway and Sweden in particular are relevant since Denmark is quite similar to other Nordic countries in language and culture [15].

## **Conclusions**

In a general population study of children with mean age 5.4 years from the Copenhagen Child Cohort 2000, mental health problems measured by the Strengths and Difficulties Questionnaire were found in 5% with conduct problems being the most common.

Male gender and several socio-economic risk factors measured from birth to child age 4 were associated with higher risk of mental health problems in children age of 5-7 years.

The result from the study replicate findings from other general population studies regarding the possible advantage of mental health in Nordic countries when focusing on conduct and hyperactivity/inattention problems.

The relatively low SDQ problems scores found in the present study might reflect the low-stress context provided by Danish kindergartens, or the greater difficulty of detecting significant hyperactivity and inattention in such a setting. Further planned follow ups of this cohort will demonstrate whether the transition to formal schooling results in a substantial increase in overt mental health problems, particularly hyperactivity-inattention. .

## **Acknowledgements**

The study was supported by The Copenhagen County Research Foundation (now called The Capital Region of Denmark), The Health Insurance Foundation, Mrs C. Hermansens Memorial Fund, The Foundation of Butcher Max Wørzner and wife, The Psychiatric Foundation of 1967, The Tryg Foundation, The Augustinus Foundation, The Danish Association for Mental Health

**Conflicts of interests**

None

Robert Goodman is director and part owner of Youth in Mind, which provides no-cost software and websites related to the SDQ.

## References

- [1] Costello,E.J., Egger,H., & Angold,A. (2005) 10-year research update review: the epidemiology of child and adolescent psychiatric disorders: I. Methods and public health burden. *J Am Acad. Child Adolesc. Psychiatry*, **44**, 972-986.
- [2] Kessler,R.C., Berglund,P., Demler,O., Jin,R., Merikangas,K.R., & Walters,E.E. (2005) Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry*, **62**, 593-602.
- [3] Angold,A. & Egger,H.L. (2007) Preschool psychopathology: lessons for the lifespan. *J Child Psychol. Psychiatry*, **48**, 961-966.
- [4] Anselmi,L., Barros,F.C., Teodoro,M.L., Piccinini,C.A., Menezes,A.M., Araujo,C.L., & Rohde,L.A. (2008) Continuity of behavioral and emotional problems from pre-school years to pre-adolescence in a developing country. *J Child Psychol. Psychiatry*, **49**, 499-507.
- [5] Costello,E.J., Mustillo,S., Erkanli,A., Keeler,G., & Angold,A. (2003) Prevalence and development of psychiatric disorders in childhood and adolescence. *Arch Gen. Psychiatry*, **60**, 837-844.
- [6] Costello,E.J., Foley,D.L., & Angold,A. (2006) 10-year research update review: the epidemiology of child and adolescent psychiatric disorders: II. Developmental epidemiology. *J Am Acad. Child Adolesc. Psychiatry*, **45**, 8-25.
- [7] Achenbach,T.M., Becker,A., Dopfner,M., Heiervang,E., Roessner,V., Steinhausen,H.C., & Rothenberger,A. (2008) Multicultural assessment of child and adolescent psychopathology with ASEBA and SDQ instruments: research findings, applications, and future directions. *J Child Psychol. Psychiatry*, **49**, 251-275.
- [8] Goodman,R. (1997) The Strengths and Difficulties Questionnaire: a research note. *J Child Psychol. Psychiatry*, **38**, 581-586.
- [9] Goodman,R. (1999) The extended version of the Strengths and Difficulties Questionnaire as a guide to child psychiatric caseness and consequent burden. *J Child Psychol. Psychiatry*, **40**, 791-799.
- [10] Goodman,R., Ford,T., Simmons,H., Gatward,R., & Meltzer,H. (2000) Using the Strengths and Difficulties Questionnaire (SDQ) to screen for child psychiatric disorders in a community sample. *Br J Psychiatry*, **177**, 534-539.
- [11] Goodman,R. (2001) Psychometric properties of the strengths and difficulties questionnaire. *J Am Acad. Child Adolesc. Psychiatry*, **40**, 1337-1345.
- [12] Bourdon,K.H., Goodman,R., Rae,D.S., Simpson,G., & Koretz,D.S. (2005) The Strengths and Difficulties Questionnaire: U.S. normative data and psychometric properties. *J Am Acad. Child Adolesc. Psychiatry*, **44**, 557-564.

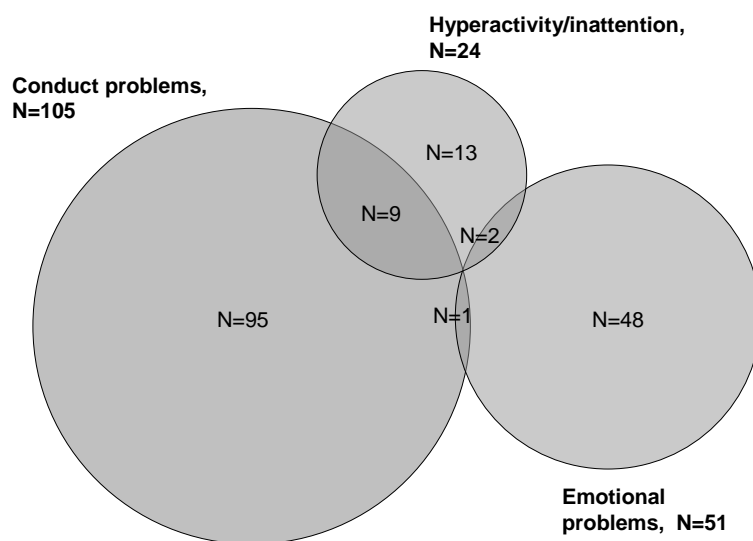


- [13] Heiervang,E., Goodman,A., & Goodman,R. (2008) The Nordic advantage in child mental health: separating health differences from reporting style in a cross-cultural comparison of psychopathology. *J Child Psychol. Psychiatry*, **49**, 678-685.
- [14] Meltzer,H., Gatward,R., Goodman,R., & Ford,T. Mental health of children and adolescents in Great Britain. 2000. London: The Stationery Office.  
Ref Type: Generic
- [15] Obel,C., Heiervang,E., Rodriguez,A., Heyerdahl,S., Smedje,H., Sourander,A., Guethmundsson,O.O., Clench-Aas,J., Christensen,E., Heian,F., Mathiesen,K.S., Magnusson,P., Njarethvik,U., Koskelainen,M., Ronning,J.A., Stormark,K.M., & Olsen,J. (2004) The Strengths and Difficulties Questionnaire in the Nordic countries. *Eur Child Adolesc. Psychiatry*, **13 Suppl 2**, II32-II39.
- [16] Heiervang,E., Stormark,K.M., Lundervold,A.J., Heimann,M., Goodman,R., Posserud,M.B., Ullebo,A.K., Plessen,K.J., Bjelland,I., Lie,S.A., & Gillberg,C. (2007) Psychiatric disorders in Norwegian 8- to 10-year-olds: an epidemiological survey of prevalence, risk factors, and service use. *J Am Acad. Child Adolesc. Psychiatry*, **46**, 438-447.
- [17] Skovgaard,A.M., Olsen,E.M., Houmann,T., Christiansen,E., Samberg,V., Lichtenberg,A., & Jorgensen,T. (2005) The Copenhagen County child cohort: design of a longitudinal study of child mental health. *Scand J Public Health*, **33**, 197-202.
- [18] Youth in Mind Goodman,R. SDQ - information for researchers and professionals about the Strengths and Difficulties Questionnaire. 2005. <http://www.sdqinfo.com>.  
Ref Type: Generic
- [19] Goodman,R., Renfrew,D., & Mullick,M. (2000) Predicting type of psychiatric disorder from Strengths and Difficulties Questionnaire (SDQ) scores in child mental health clinics in London and Dhaka. *Eur Child Adolesc. Psychiatry*, **9**, 129-134.
- [20] Obel,C., Dalsgaard,S., Stax,H.P., & Bilenberg,N. (2003) [Strengths and Difficulties Questionnaire (SDQ-Dan). A new instrument for psychopathologic screening of children aged 4-16 years]. *Ugeskr Laeger*, **165**, 462-465.
- [21] Rothman KJ & Greenland S. Modern epidemiology, chapter 15. 1998. 2nd Ed. New York, NY: Lippicott.  
Ref Type: Generic
- [22] Christensen,E. [The first 7 years of life]. 2004. Copenhagen , The Danish national centre for social research.  
Ref Type: Generic
- [23] Kaptein,S., Jansen,D.E., Vogels,A.G., & Reijneveld,S.A. (2008) Mental health problems in children with intellectual disability: use of the Strengths and Difficulties Questionnaire. *J Intellect. Disabil. Res*, **52**, 125-131.
- [24] Ravens-Sieberer,U., Wille,N., Erhart,M., Bettge,S., Wittchen,H.U., Rothenberger,A., Herpertz-Dahlmann,B., Resch,F., Holling,H., Bullinger,M., Barkmann,C., Schulte-Markwort,M., & Dopfner,M. (2008) Prevalence of mental health problems among children

and adolescents in Germany: results of the BELLA study within the National Health Interview and Examination Survey. *Eur Child Adolesc. Psychiatry*, **17 Suppl 1**, 22-33.

- [25] Shojaei,T., Wazana,A., Pitrou,I., & Kovess,V. (2008) The strengths and difficulties questionnaire: validation study in French school-aged children and cross-cultural comparisons. *Soc Psychiatry Psychiatr. Epidemiol.*
- [26] Petersen,D.J., Bilenberg,N., Hoerder,K., & Gillberg,C. (2006) The population prevalence of child psychiatric disorders in Danish 8- to 9-year-old children. *Eur Child Adolesc. Psychiatry*, **15**, 71-78.
- [27] Friedman RJ & Chase-Landsdale PL. Chronic Adversities. [In Rutter& Taylor (eds) *Child and Adolescent Psychiatry*], 261-276. 2002. Oxford Blackwell Science.  
Ref Type: Generic
- [28] World Health Organization. Process of translation and adaptation of instruments. 2009. [http://www.who.int/substance\\_abuse/research\\_tools/translation/en/index.html](http://www.who.int/substance_abuse/research_tools/translation/en/index.html).  
Ref Type: Generic

**Figure1** Comorbidity in children with abnormal SDQ subscores; N=168



**Table 1** Characteristics of the entire birth cohort CCC2000 at the 5-7 years follow-up and attrition analyses based on register data on socioeconomic and perinatal variables

Socioeconomic and perinatal variables	Entire cohort N=6,072 N (%)	Responders N=3,501 N (%)	Non- responders N=2,571 N (%)	P-value** Number and missing
Gender: Boys	3,116 (51.3 %)	1,775 (50.7 %)	1,341 (52.2 %)	0.261; Missing=0
<b>Birth weight, gram:</b> <1500 1500-2499 2500-4499 >4500	42 (0.7 %) 236 (4.0 %) 5,497 (92.3 %) 178 (3.0 %)	23 (0.7 %) 118 (3.5 %) 3,158 (92.3 %) 123 (3.6 %)	19 (0.8 %) 118 (4.7 %) 2,339 (92.4 %) 55 (2.2 %)	0.001 Missing=119
<b>Gestational age:</b> 0-31 weeks 32-36 weeks 37+ weeks	45 (0.8 %) 334 (5.6 %) 5,630 (93.7 %)	28 (0.8 %) 173 (5.0 %) 5,257 (94.2 %)	17 (0.7 %) 161 (6.3 %) 2,373 (93.0 %)	0.078 Missing =63
<b>Apgar Score, score 0-10</b> 0-3 4-6 7-10	6 (0.1 %) 31 (0.5 %) 5,933 (99.4 %)	5 (0.2 %) 15 (0.4 %) 3,412 (99.4 %)	1 (0.04 %) 16 (0.6 %) 2,521 (99.3 %)	0.2371 Missing=102
<b>Birth complications: Yes</b>	530 (8.7 %)	308 (8.8 %)	222 (8.6 %)	0.8243; Missing= 0
<b>Serious malformation: Yes</b>	174 (2.9 %)	106 (3.0 %)	68 (2.6 %)	0.3752; Missing =0
<b>Register-based Psychiatric diagnosis, before the age of five: Yes</b> No	102 (1.7 %) 5,970 (98.3 %)	52 (1.5 %) 3,449 (98.5 %)	50 (1.9 %) 2,521 (98.1 %)	0.1709 Missing=0
<b>Immigrant status</b> 2 parents born in Denmark 1 parent born in Denmark 0 parent born in Denmark	4,278 (72.3 %) 692 (11.7 %) 944 (16.0 %)	2,598 (75.8 %) 391 (11.4 %) 437 (12.8 %)	1,680 (67.5 %) 301 (12.1 %) 507 (20.4 %)	<0.0001 Missing= 158
<b>Maternal age at child birth</b> 16-20 years 21-30 years 31-40 years 41-46 years	225 (3.7 %) 3,124 (51.6 %) 2,622 (43.3 %) 84 (1.4 %)	93 (2.7 %) 1,744 (50.0 %) 1,595 (45.7 %) 57 (1.6 %)	132 (5.1 %) 1,380 (53.8 %) 1,027 (40.0 %) 27 (1.1 %)	<0.0001 Missing=17
<b>Parents living together at child birth: Yes</b>	5,558 (91.8 %)	3,242 (92.9 %)	2,316 (90.3 %)	<0.0002 Missing=17
<b>Maternal education (ISCED*) at child birth</b> 1-10 years 11-14 years 15+ years	1,351 (23.8 %) 2,940 (51.7 %) 1,393 (24.5 %)	650 (19.6%) 1,705 (51.4%) 960 (29.0%)	701 (29.6 %) 1,235 (52.1 %) 433 (18.3 %)	<0.0001 Missing=388
<b>Family constitution at child birth:</b> 1) living with both parents 2) Living with one parent 3) Living in a reconstituted family 4)Living without any parents	5,041 (83.3 %) 670 (11.1 %) 327 (5.4 %) 14 (0.2 %)	2,993 (85.6%) 330 (9.4%) 169 (4.8%) 6 (0.2%)	2,048 (80.2 %) 340 (13.3 %) 158 (6.2 %) 8 (0.3 %)	<0.0001 Missing=20
<b>Changes in family composition in the first 5 years of life:</b> Yes:	944 (15.6 %)	484 (13.8 %)	460 (18 %)	<0.0001 Missing=16
<b>Household income at child birth:</b> 1. Quartile (lowest) 2. Quartile 3. Quartile 4. Quartile (highest)	1,497 1,497 1,497 1,498	711 (20.4 %) 861 (24.8 %) 925 (26.6 %) 981 (28.2 %)	786 (31.3 %) 636 (25.3 %) 572 (22.8 %) 517 (20.6 %)	<0.0001 Missing= 83

\*ISCED= The International Standard Classification of Education (ISCED) designed by UNESCO

\*\* Likelihood Ratio Chi-square test probability for comparison of responders and non-responders

Mental health problems	Boys N=1,775	Girls N=1,726	All N=3,501	Risk Ratio	P-Value*				
SDQ scores	% Abnormal	% Borderline	% Normal	Missings	P-value*	Mean	P-value**	Kappa	
Any diagnosis	6.4 % (N=114)	3.1 % (N=54)	4.8 (4.1-5.6) % (N=168)	N=7	2.0 (1.5-2.8)	<0.0001	Score (SD)		
Total difficulties	1.8 (N=31)	1.4 (N=20)	1.5 (1.1-1.9) % (N=51)	P=7	1.5 (0.9-2.6)	<0.001	P: 5.9 (4.6)	<0.001	0.27 (0.19-0.34)
Emotional problems	4.2 (N=75)	1.7 (N=30)	3.0 (2.4-3.6) % (N=105)	T=22	2.4 (1.6-3.7)	<0.0001	T: 5.3 (5.3)		
Conduct problems	1.0 (N=18)	0.4 (N=6)	0.7 (0.4-1.0) % (N=24)	P=5	2.9 (1.2-7.3)	<0.001	P: 1.6 (1.8)	<0.001	0.19 (0.13-0.26)
Hyperactivity inattention symptom score	1.1 % (N=20)	1.1 % (N=19)	1.1 % (N=39)	T=21			T: 1.3 (1.8)		
Missing	P: 6.5	P: 8.5	P: 85.1	P=5	<0.001		P: 1.2 (1.3)	<0.001	0.22
Conduct									

The SDQ algorithm can generate more than one prediction of mental health problems and therefore the child can be placed in more than one category.

**Table 2** 6-month point prevalence rates of mental health problems predicted by the Strengths and Difficulties Questionnaire including all reports from parents and/or pre-school teachers (n=3,501)

\* Likelihood Ratio Chi-Square test Probability for comparison of boys and girls

<b>problem score</b>	T:8.1	T:5.6	T:86.3	T= 20		T:0.9 (1.5)		(0.16-28.7)
<b>Hyperactivity score</b>	P:5.6 T:9.0	P:3.3 T:3.5	P:91.1 T:87.5	P= 6 T= 20	<0.001	P:2.4 (2.1) T:2.2 (2.6)	<0.001	0.29 (0.23-0.36)
<b>Peer problem score</b>	P:6.4 T:4.3	P:5.1 T:2.7	P:88.5 T:92.9	P= 6 T= 20	<0.001	P:0.8 (1.4) T:0.8 (1.5)	0.3124	0.30 (0.22-0.38)
<b>Prosocial score</b>	P:1.9 T:9.0	P:3.9 T:8.1	P:94.3 T:82.9	P= 4 T= 21	<0.001	P:8.3 (1.6) T:7.8 (2.2)	<0.001	0.09 (0.04-0.14)
<b>Impact score</b>	P:4.8 T:6.2	P:3.3 T:7.1	P:91.9 T:86.7	P= 45 T= 72	<0.001	P:0.2 (0.9) T:0.2 (0.7)	0.003	

**Table 3** Comparison of parent and pre-school teacher rated SDQ symptom scores (N=2,442)

P: parent SDQ

T: pre-school teacher SDQ

\* Statistics: Test of Marginal Homogeneity for SDQ symptoms scores by parent and pre-school teachers

\*\* Statistics: Wilcoxon signed rank test for difference in means scored by parents and pre-school teachers

\*\*\*The agreement of parents and pre-school teachers as indicated by Kappa values

**Table 5** Multivariate associations of mental health problems with perinatal and socioeconomic variables. Mental health problems is predicted to be probable or not present

	Multivariate analyses		
	cases/N	OR (95% CI)	P-value****
<b>Perinatal and socioeconomic variables</b>			
<b>Gender**:</b> Boys	113/1748	2.11 (1.52-2.95)	<0.0001
Girls	54/1702	ref	
<b>Maternal age at child birth**</b>			0.001
16-20 years	12/92	2.65 (1.39 -5.06)	
21-30 years	92/1722	ref	
31-40 years	61/1579	0.71 (0.51-0.99)	
41-46 years	2/57	0.67 (0.16-2.79)	
<b>Maternal education (ISCED) at child birth***</b>			0.0589
1-10 years	44/633	1.20 (0.80-1.80)	
10-14 years	84/1686	ref	
15+ years	30/951	0.66 (0.43-1.01)	
<b>Household income, at child birth***</b>			0.001
1. Quartile (highest)	20/975	0.46 (0.26-0.80)	
2. Quartile	41/914	ref	
3. Quartile	50/845	1.33 (0.87 -2.04)	
4. Quartile (lowest)	54/694	1.63 (1.05-2.54)	

<b>Structure of the Family constitution at child birth***</b>			
1) living with both parents	122/2948	ref	
2) Living in reconstituted family	10/168	1.36 (0.69-2.65)	
3) Living with one parent	32/325	2.21 (1.45-3.38)	
4 ) Living without any parents	2/6	12.83(2.13-77.18)	0.0001
<b>Gestational Age***</b>			
<31 weeks	4/28	3.154 (1.06-9.39)	
32-36 weeks	7/169	0.86 (0.40-1.87)	
37-43 weeks	155/3222	ref	0.1078

\* Adjusted for maternal age

\*\*Adjusted for gender

\*\*\*Adjusted for maternal age and gender

\*\*\*\*Wald chi-Square, type 3 analysis of effects of the explanatory variable in the logistic regression.

**Table 4** Univariate associations of mental health problems with perinatal and socioeconomic variables (N=3501)

Perinatal and socioeconomic variables	<b>Unlikely</b> N=2770 (79.1%)  % (N)	<b>Possible</b> N=513 (14.7%)  % (N)	<b>Probable</b> N=168 (4.8%)  % (N)	P-value**	Missing  N
<b>Sex:</b> Boys Girls	76.4 % (1340) 84.4 % (1441)	17.2 % (301) 12.4 % (212)	6.5 % (114) 3.2 % (54)	<0.0001	39
<b>Register-based Psychiatric diagnosis before the age of five:</b> Yes No	46.8 % (22) 80.8 % (2759)	19.2 % (9) 14.8 % (504)	34.0 % (16) 4.5 % (152)	< 0.0001	39
<b>Immigrant status:</b> 2 parents born in Denmark 1 parent born in Denmark 0 parent born in Denmark	81.5 % (2104) 81.2 % (310) 73.0 % (308)	13.8 % (356) 14.7 % (56) 20.6 % (87)	4.8 % (123) 4.2 % (16) 6.4 % (27)	0.0029	114
<b>Maternal age at child birth:</b> 16-20 years 21-40 years 41-46 years	69.6 % (64) 80.6 % (2659) 82.5 % (47)	17.4 % (16) 14.8 % (489) 14.0 % (8)	13.0 % (12) 4.6 % (153) 3.5 % (2)	0.03 (Fisher test: 0.01)	51
<b>Maternal education (ISCED*) at child birth:</b> 1-10 years 11-14 years 15+ years	72.8 % (462) 81.2 % (1372) 84.8 % (811)	20.3 % (129) 13.7 % (232) 12.3 % (115)	6.9 % (44) 5.0 % (85) 3.1 % (30)	< 0.0001	221
<b>Household income at child birth:</b> 1. Quartile (lowest) 2. Quartile 3. Quartile 4. Quartile (highest)	72.7 % (506) 78.9 % (671) 81.8 % (748) 85.7 % (838)	19.4 % (135) 15.2 % (129) 13.8 % (126) 12.3 % (120)	7.9 % (55) 5.9 % (50) 4.5 % (41) 2.0 % (20)	<0.0001	62
<b>Structure of the Family constitution at child birth:</b> 1) living with both parents 2) Living with one parent 3) Living in reconstituted family 4 ) Living without any parents	81.2 % (2404) 81.0 % (136) 72.1 % (235) 66.7 % (4)	14.6 % (432) 13.1 % (22) 18.1 % (59) 0 % (0)	4.2 % (123) 6.0 % (10) 10.0 % (32) 33.3 % (2)	<0.0001	42

<b>Changes in family composition in the first 5 year of life:</b>					
0 time (never)	81.52 % (2431)	14.5 % (431)	4.1 % (121)	<0.0001	39
1 time	73.5 % (291)	16.9 % (67)	9.6 % (38)		
2 times	73.1 % (49)	16.4 % (11)	10.5 % (7)		
3 times	62.5 % (10)	25.0 % (4)	12.5 % (2)		

\*ISCED= 'Internatioanl Standard Classification of Education' designed by UNESCO

\*\* Likelihood Ratio Chi-Square test probability for comparison of mental health problems predicted to be unlikely, possible and probable